US009227696B2

(12) **United States Patent**
Yamaguchi

(10) **Patent No.: US 9,227,696 B2**
(45) **Date of Patent: Jan. 5, 2016**

(54) **BICYCLE DERAILLEUR**

(71) Applicant: **Shimano Inc.**, Sakai, Osaka (JP)

(72) Inventor: **Sota Yamaguchi**, Osaka (JP)

(73) Assignee: **Shimano Inc.**, Osaka (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 327 days.

(21) Appl. No.: **13/952,461**

(22) Filed: **Jul. 26, 2013**

(65) **Prior Publication Data**

US 2015/0031483 A1 Jan. 29, 2015

(51) **Int. Cl.**
B62M 9/1242 (2010.01)
B62M 9/126 (2010.01)

(52) **U.S. Cl.**
CPC ***B62M 9/1242*** (2013.01); ***B62M 9/126*** (2013.01)

(58) **Field of Classification Search**
CPC ... B62M 9/126; B62M 9/1242; B62M 9/1246
USPC 474/109, 110, 111, 140, 80, 82
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,724,976 A * 11/1955 Cartlidge F16H 7/06 474/111
3,583,249 A * 6/1971 Morse B62M 9/126 474/80
4,061,048 A * 12/1977 Huret B62M 9/126 474/82
4,637,808 A * 1/1987 Nakamura B62M 9/16 474/80
6,793,598 B1 * 9/2004 Savard B62M 9/1248 474/80
7,674,198 B2 3/2010 Yamaguchi
2007/0026985 A1 * 2/2007 Yamaguchi B62M 9/1242 474/82
2008/0064545 A1 * 3/2008 Yamaguchi B62M 9/16 474/82
2009/0062045 A1 * 3/2009 Kunisawa B62M 9/126 474/82
2014/0057749 A1 * 2/2014 Konno F16H 7/18 474/111
2014/0162821 A1 * 6/2014 Braedt F16H 55/30 474/155
2015/0024889 A1 * 1/2015 Konno F16H 7/18 474/111

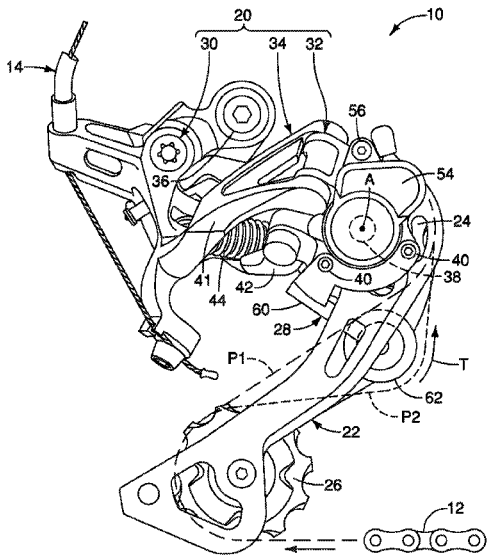
* cited by examiner

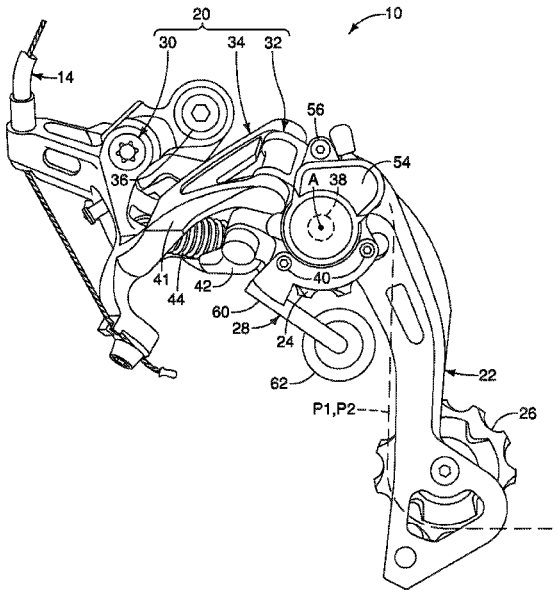
Primary Examiner — William E Dondero
Assistant Examiner — Robert T Reese
(74) *Attorney, Agent, or Firm* — Global IP Counselors

(57) **ABSTRACT**

A bicycle derailleur is basically provided with a main body, a chain cage, a first pulley, a second pulley and a chain contact member. The main body is configured to be mounted to a bicycle. The chain cage is pivotally coupled to the main body movement between at least a first orientation and a second orientation. The first pulley is rotatably coupled to one of the chain cage and the main body. The second pulley is rotatably mounted to the chain cage to move therewith relative to the main body. The chain contact member is coupled to the main body. The chain contact member includes a non-rotatable chain contact portion that projects into a chain path between the first and second pulleys while the chain cage is in the first orientation, and that is located outside of the chain path between the first and second pulleys while the chain cage is in the second orientation.

14 Claims, 15 Drawing Sheets





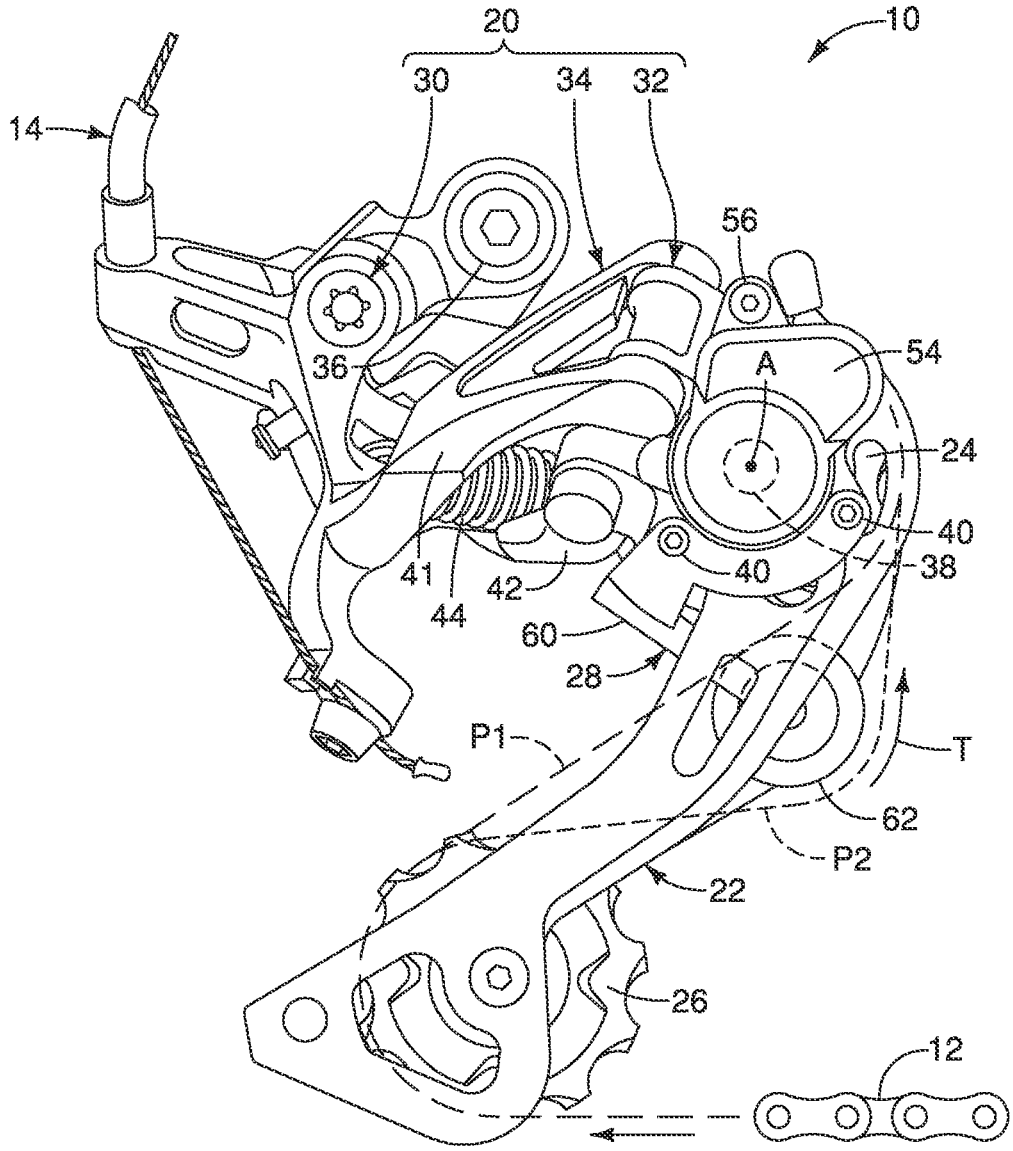

20
10
30
34
32
14
56
36
A
54
24
40
41
42
40
38
44
60
28
P1
T
62
P2
22
26
12

FIG. 1

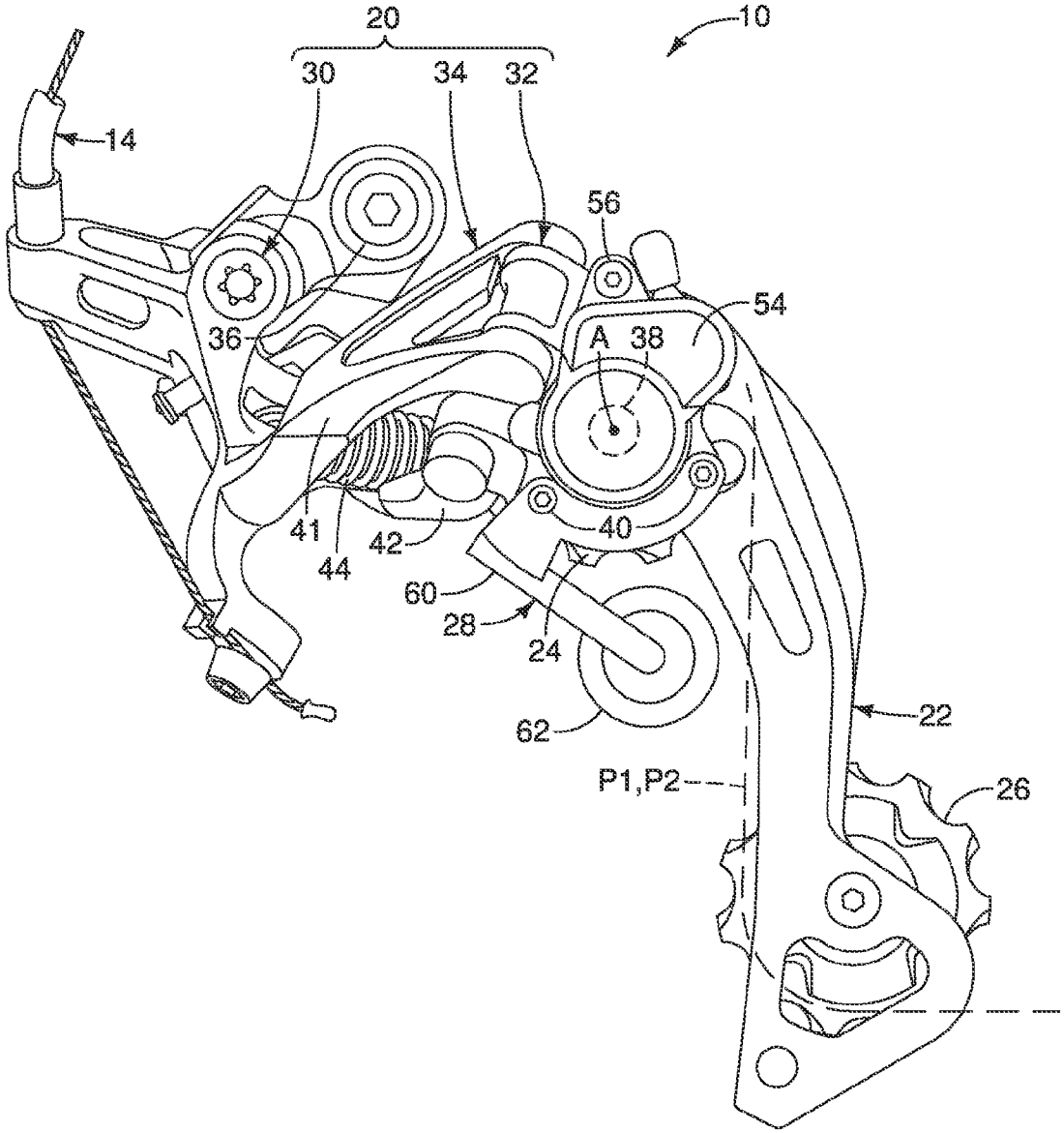


FIG. 2

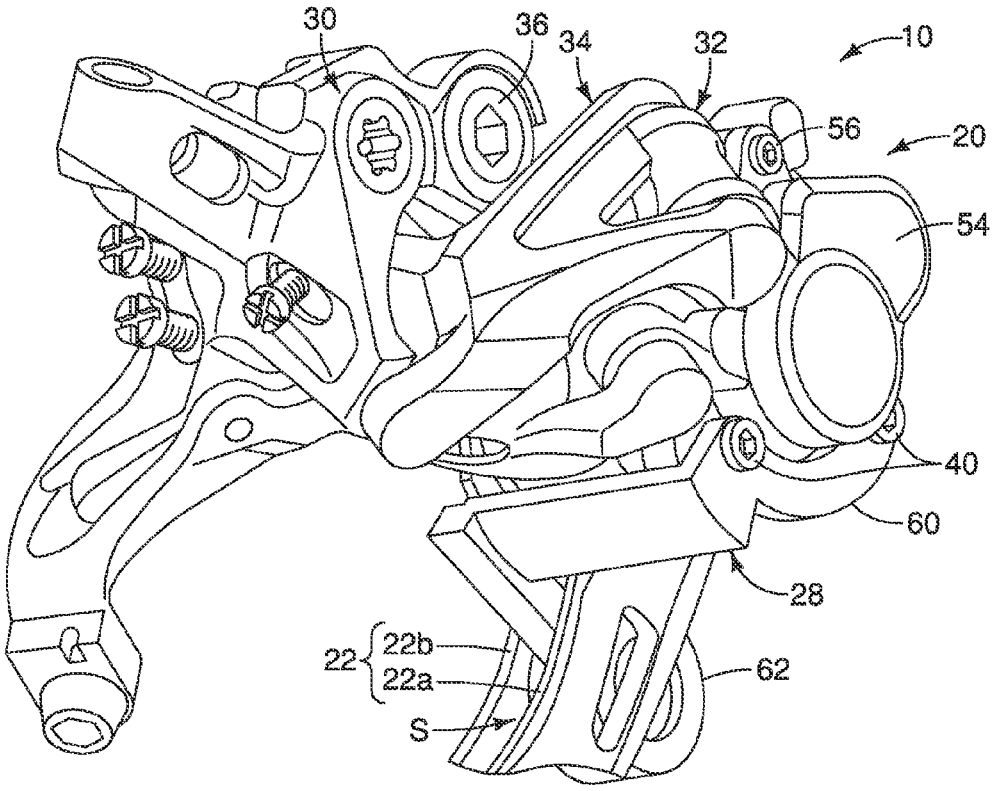

30
36
34
32
10
56
20
54
40
60
28
22
22b
22a
62
S

FIG. 3

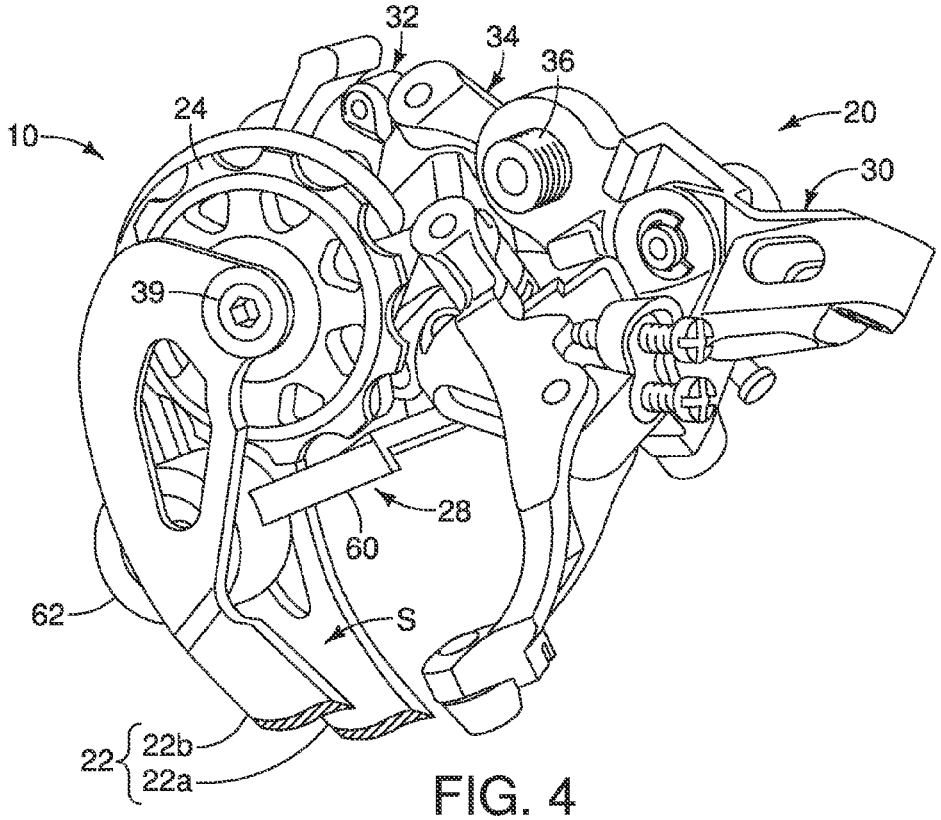

32
34
36
24
10
20
30
39
28
60
62
S
22
22b
22a

FIG. 4

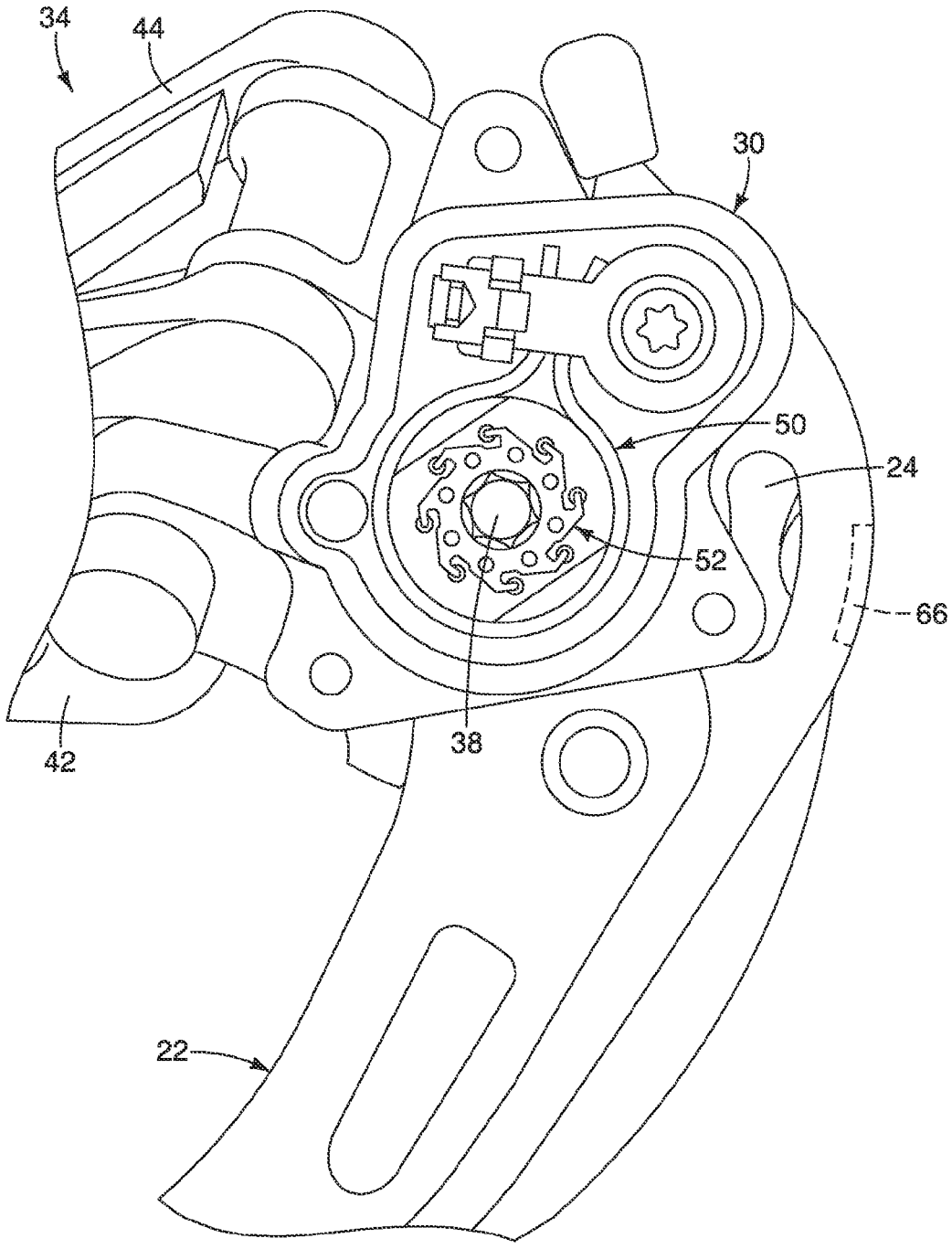


FIG. 5

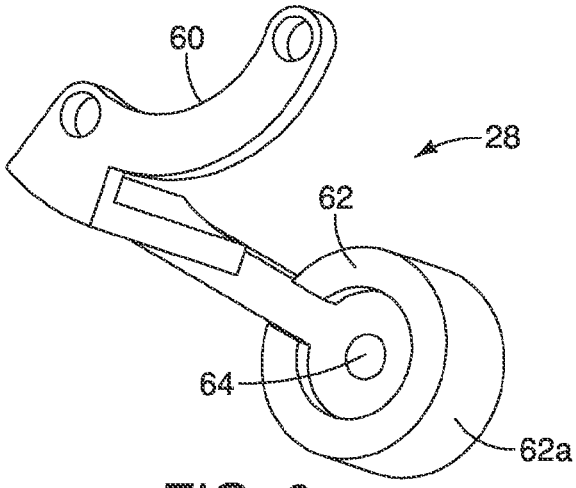


FIG. 6

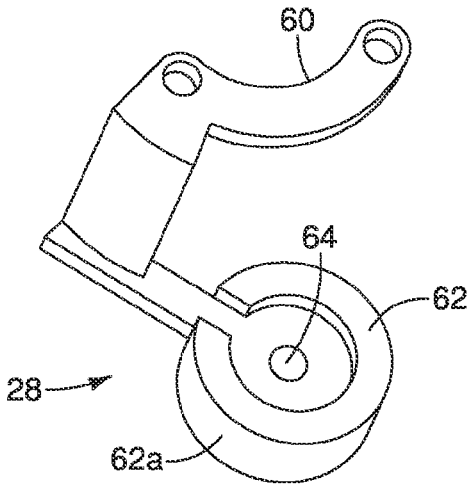


FIG. 7

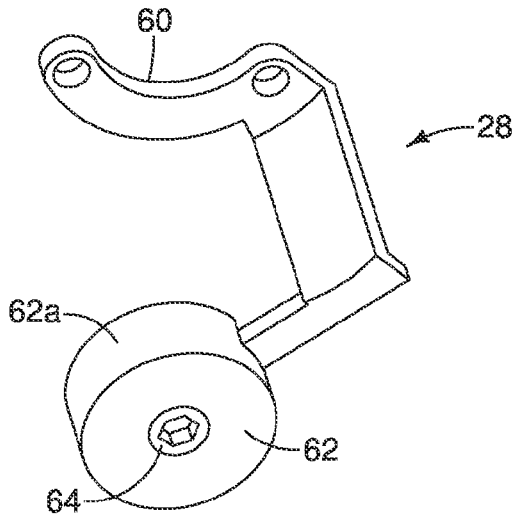


FIG. 8

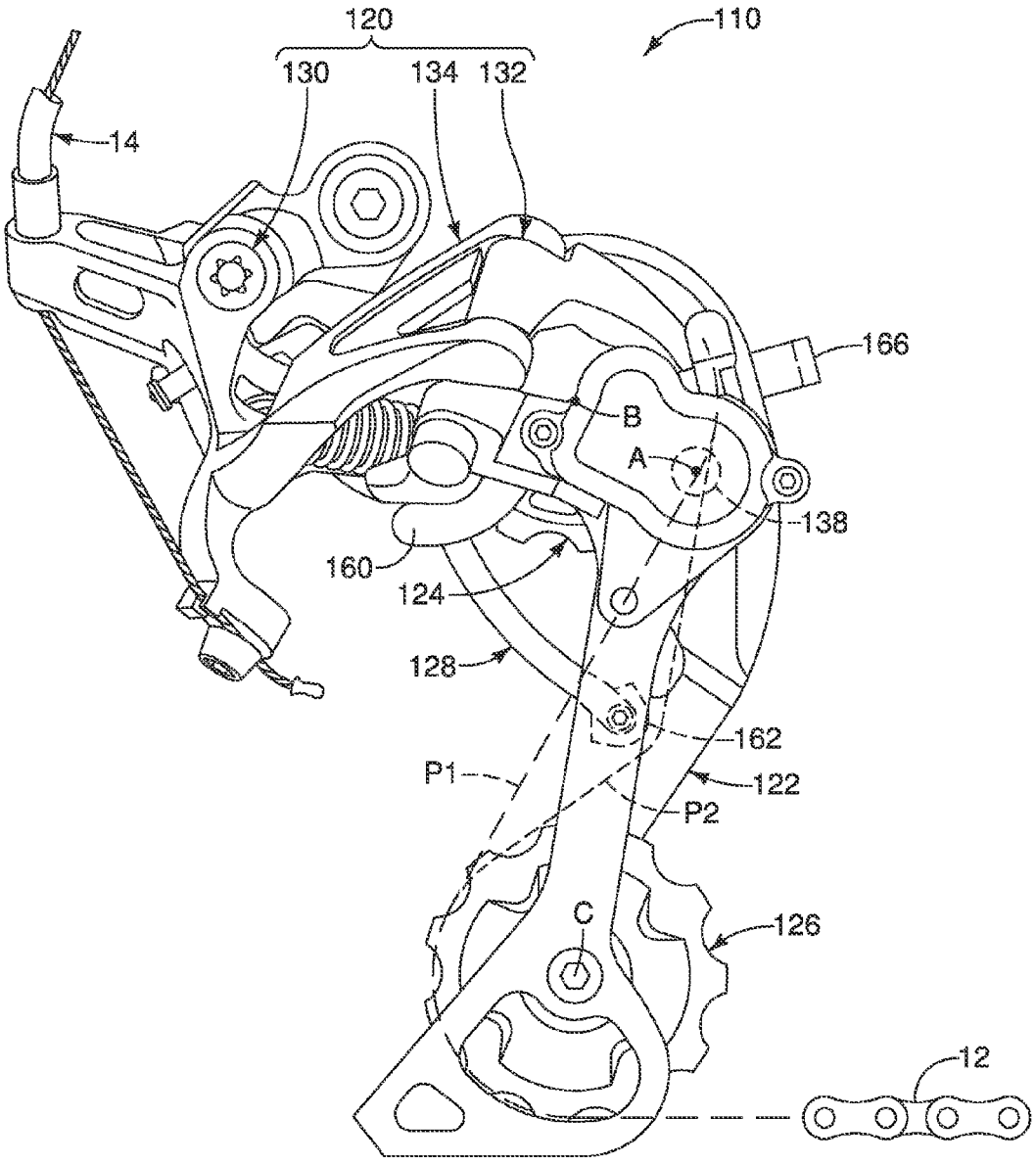

120
110
130
134
132
14
166
B
A
138
160
124
128
162
P1
122
P2
C
126
12

FIG. 9

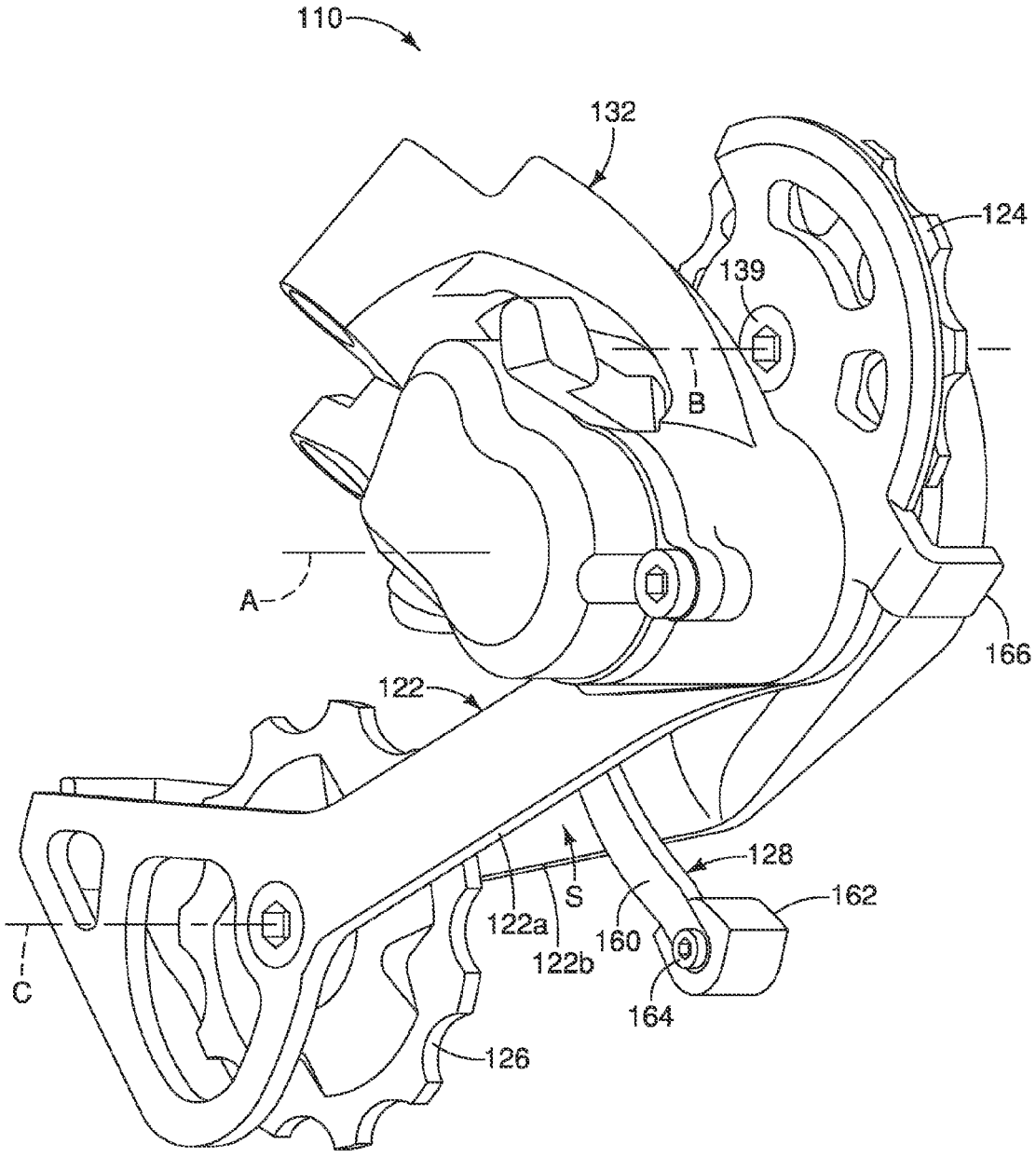


FIG. 10

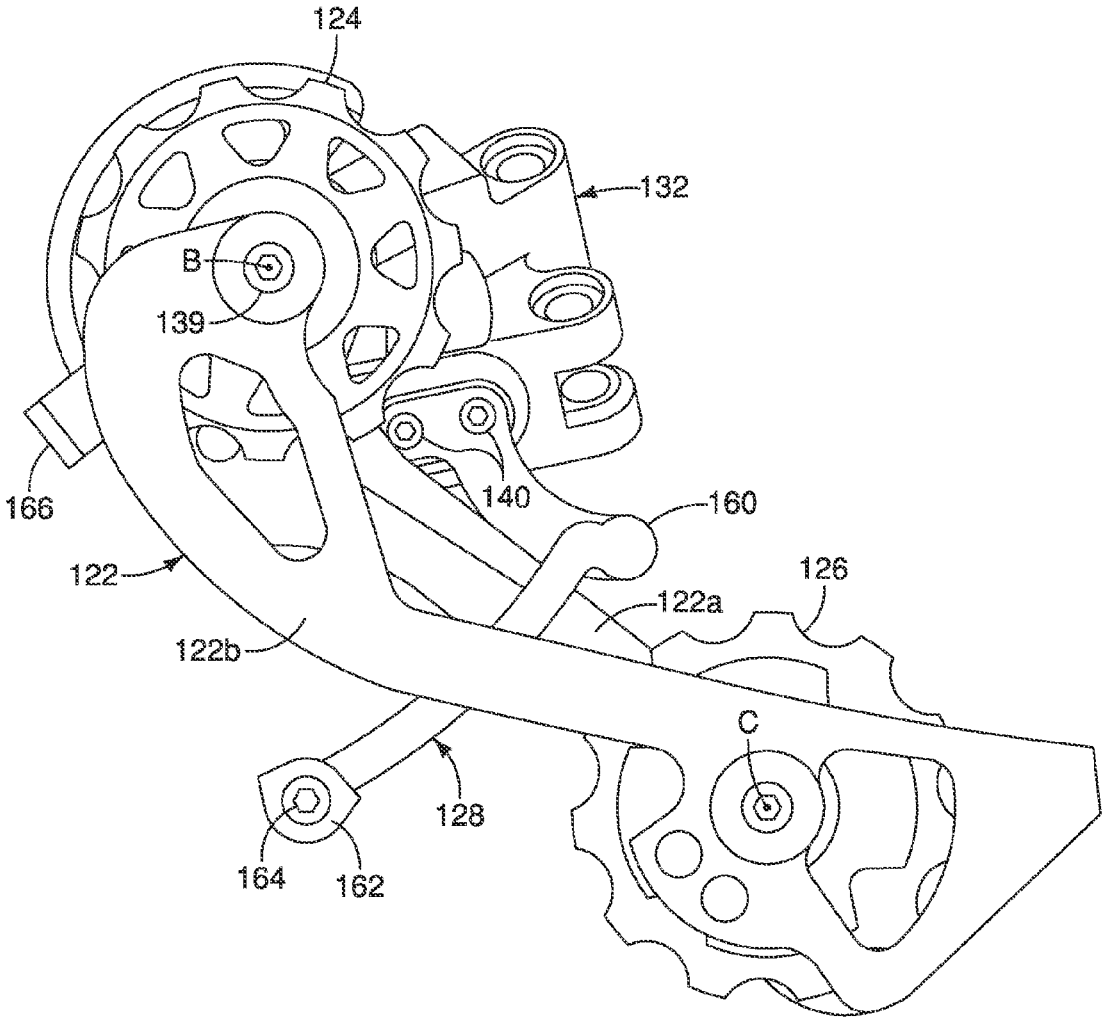


FIG. 11

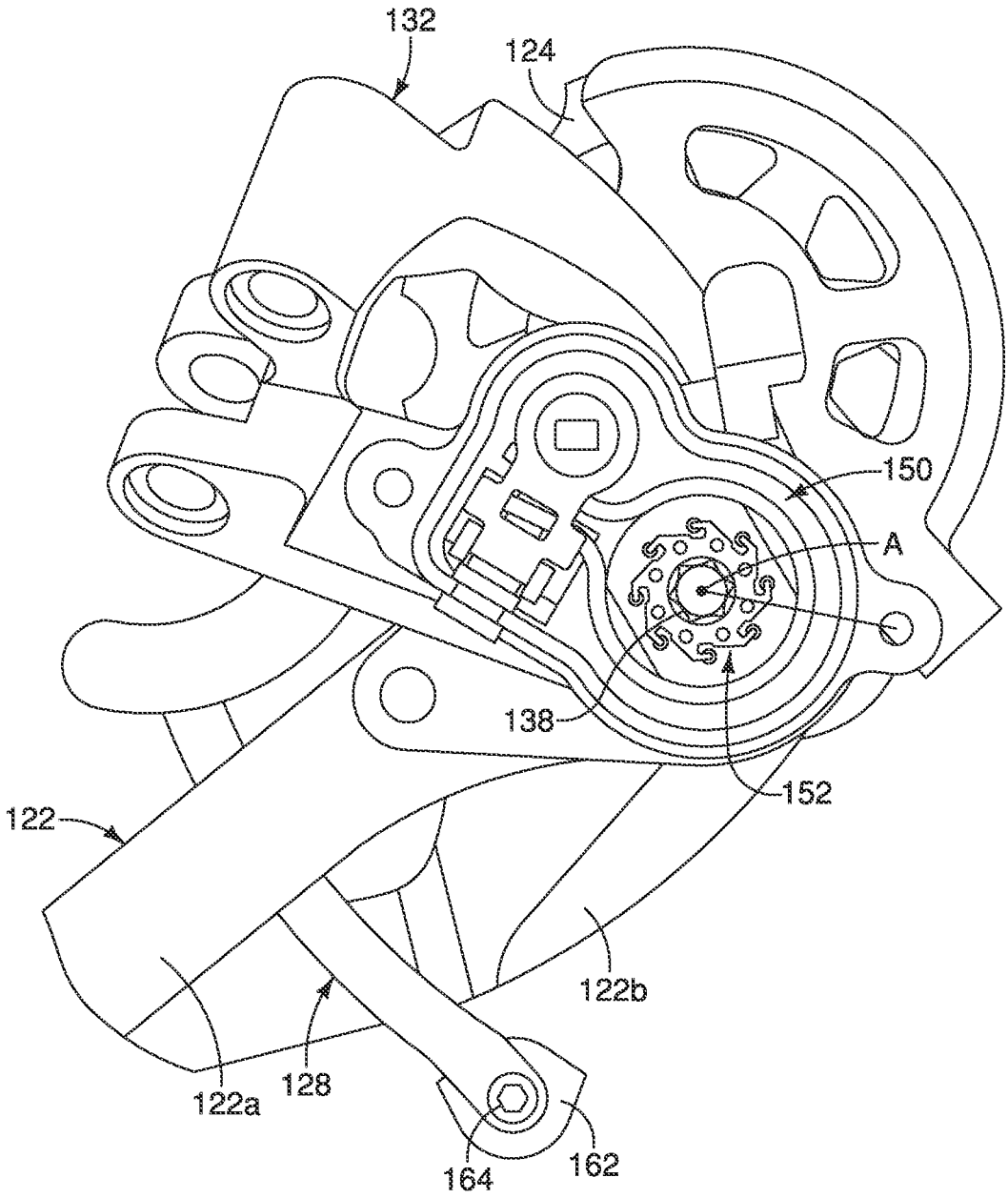


FIG. 12

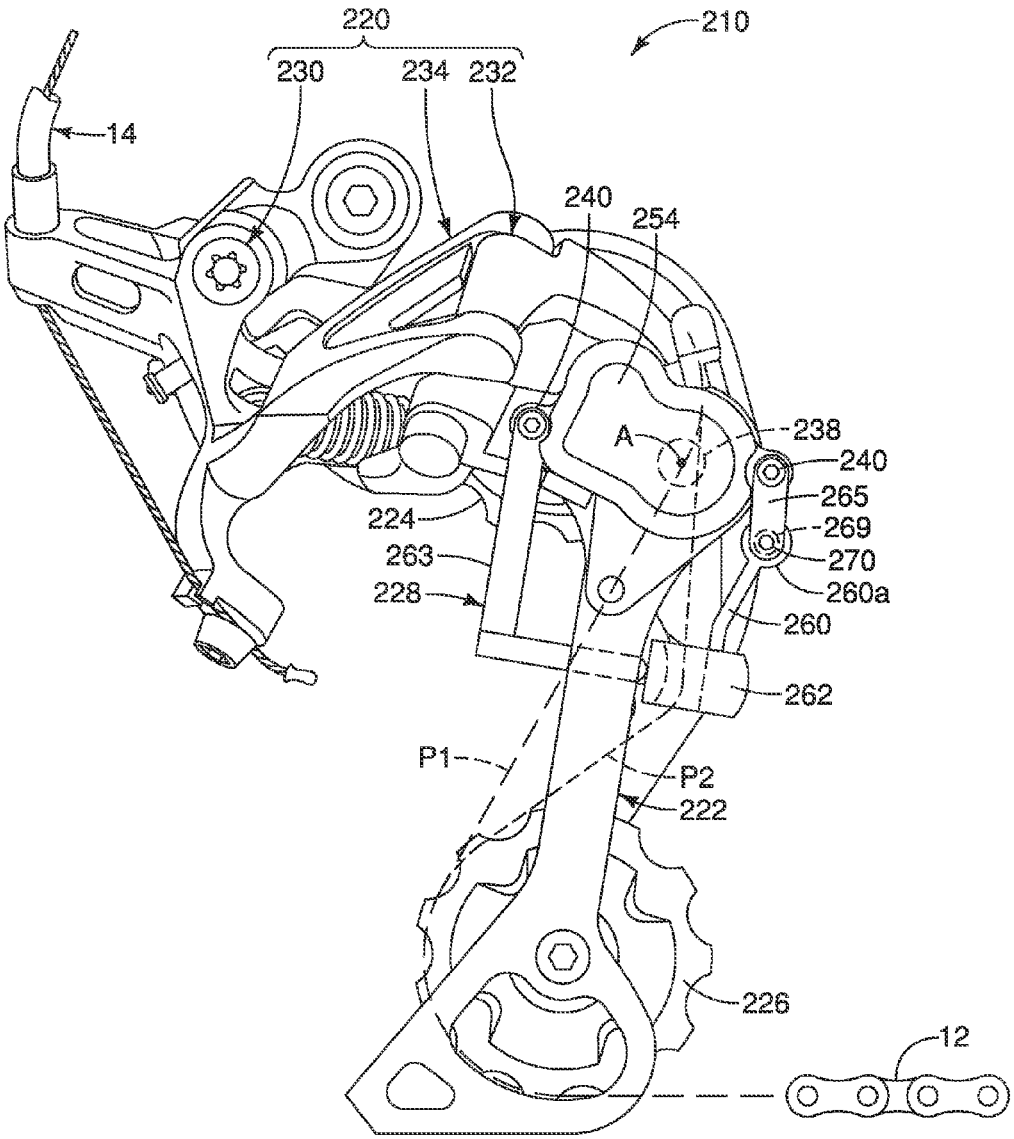

220
210
230
234
232
14
240
254
A
238
240
265
269
270
260a
260
224
263
228
262
P1
P2
222
226
12

FIG. 13

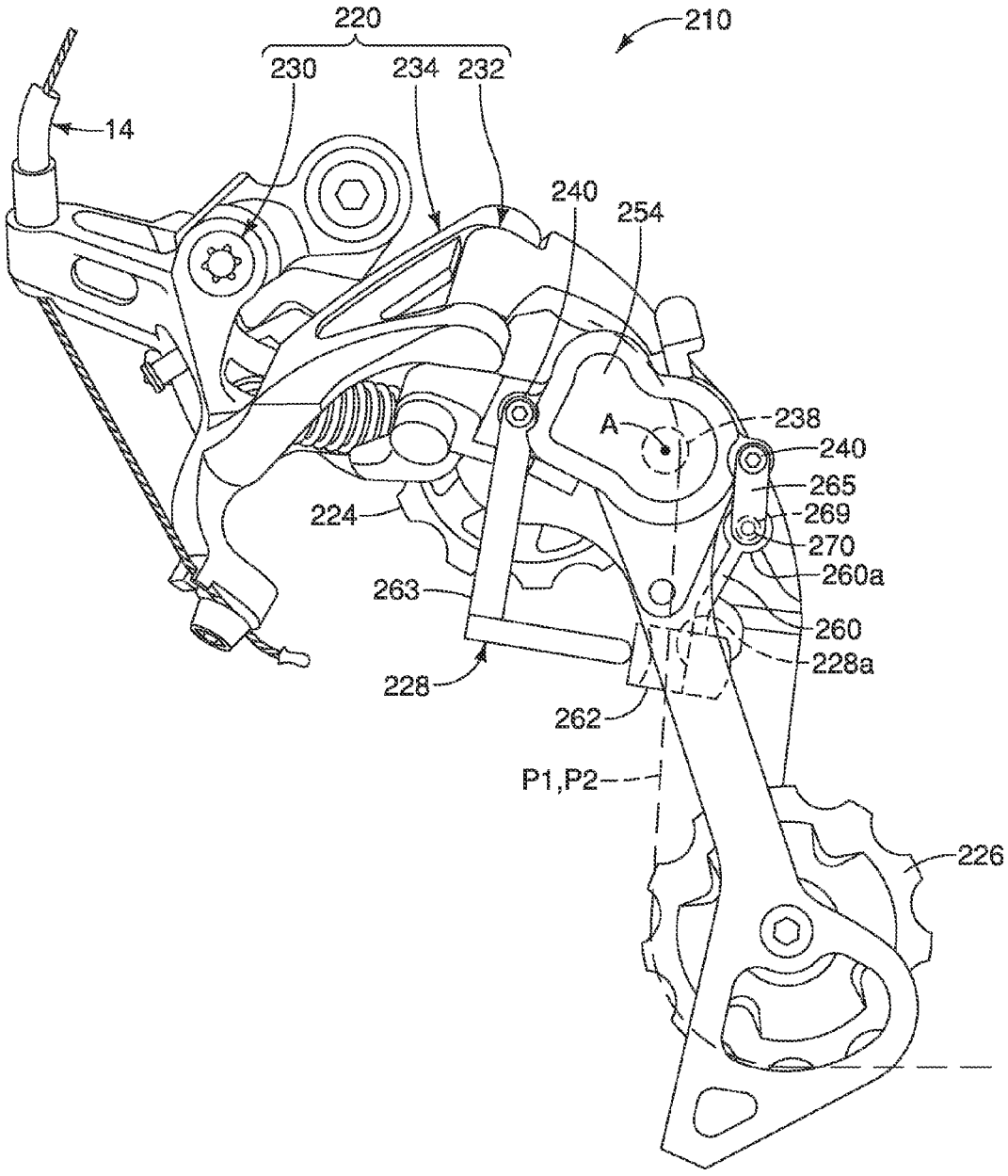

220
210
230
234
232
14
240
254
A
238
240
265
269
270
260a
224
263
260
228a
228
262
P1,P2
226

FIG. 14

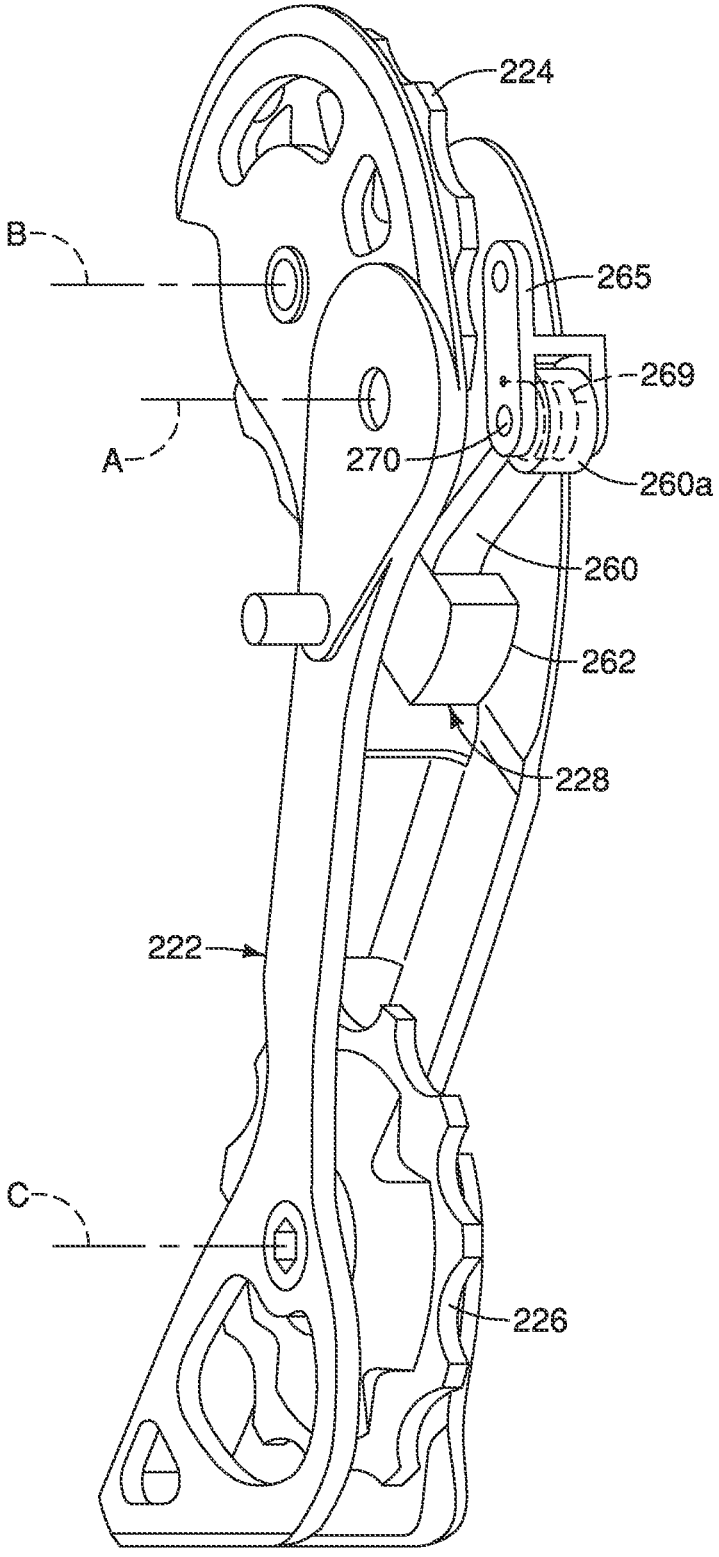


FIG. 15

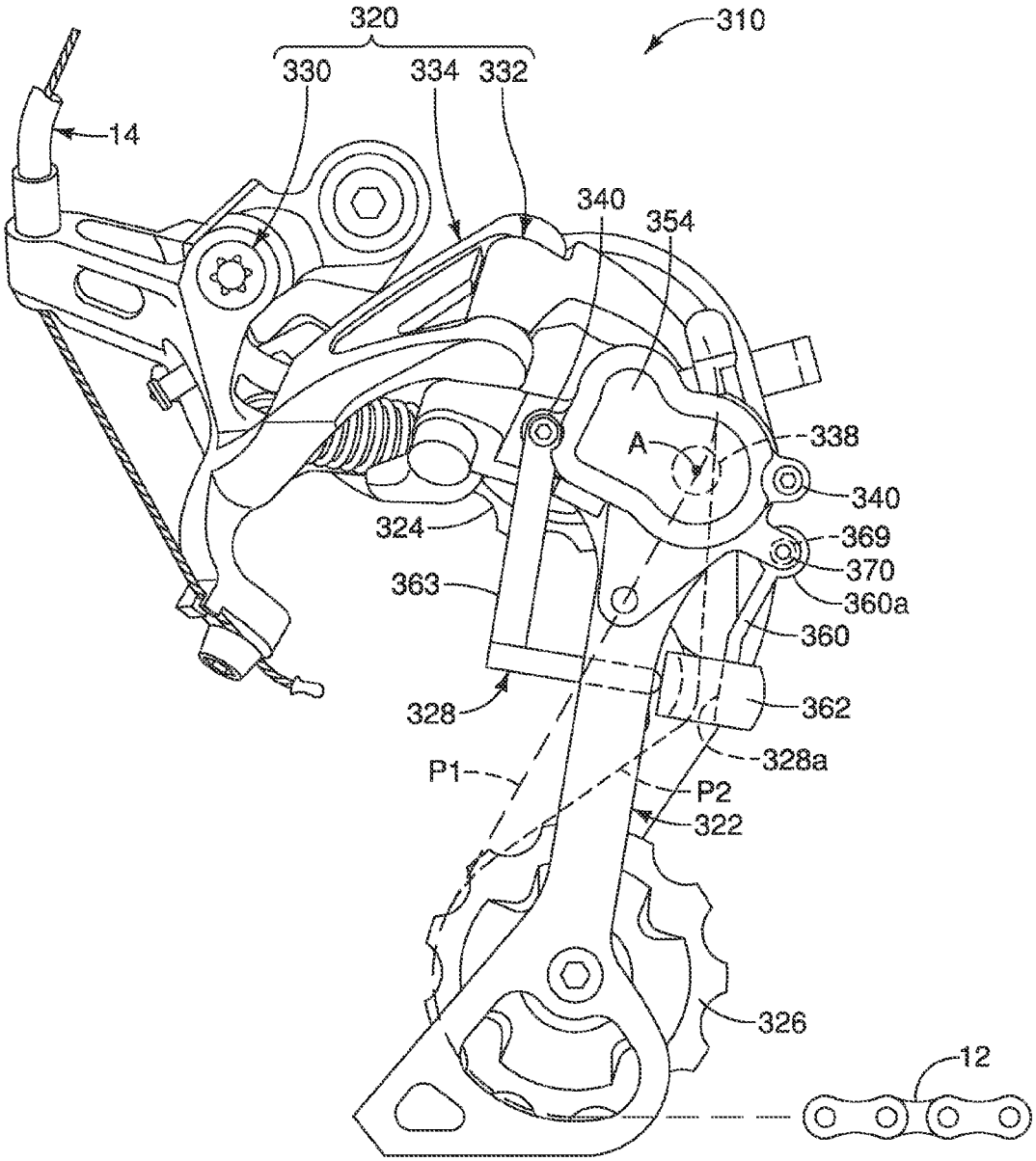

320
310
330
334
332
14
340
354
A
338
340
324
369
370
363
360a
360
328
362
328a
P1
P2
322
326
12

FIG. 16

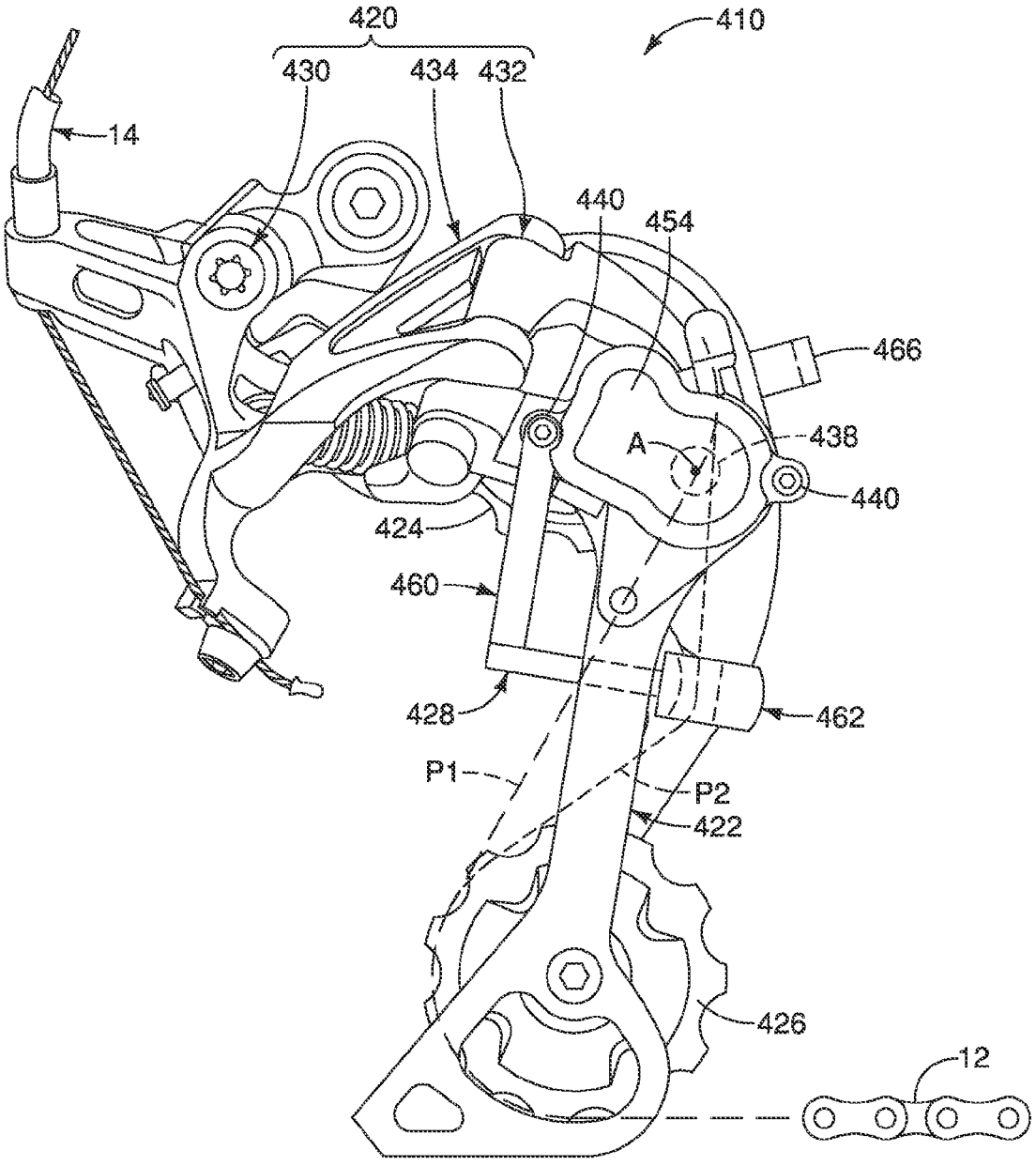

420
410
430
434
432
14
440
454
466
A
438
440
424
460
428
462
P1
P2
422
426
12

FIG. 17

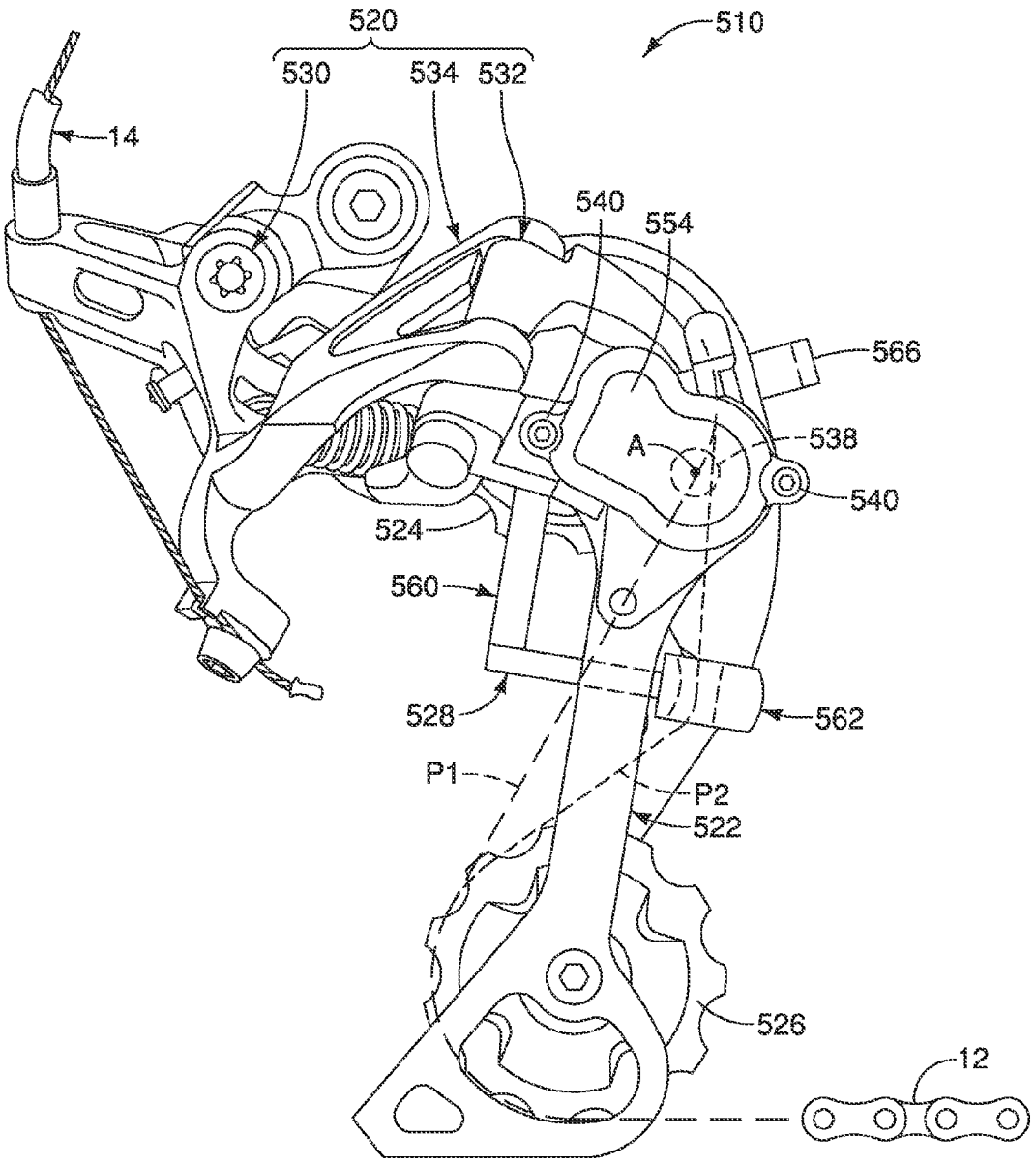

520
510
530
534
532
14
540
554
566
538
A
540
524
560
528
562
P1
P2
522
526
12

FIG. 18

BICYCLE DERAILLEUR

BACKGROUND

1. Field of the Invention

This invention generally relates to a bicycle derailleur. More specifically, the present invention relates to a bicycle derailleur that includes a chain cage with at least one pulley rotatably mounted to the chain cage.

2. Background Information

A bicycle typically uses a chain drive transmission for transmitting a pedaling force to a rear wheel. The chain drive transmission of a bicycle often uses derailleurs to selectively move a chain from one of a plurality of sprockets to another fir changing speeds of the bicycle. A typical derailleur has a base member, a movable member supporting a chain guide and a linkage assembly (e.g., a moving mechanism) coupled between the base member and the movable member so that the chain cage moves laterally relative to the base member. In the case of a rear derailleur, typically two pulleys are provided such that as the chain cage and the pulleys compensate for the chain being shifted to change a gear ratio.

SUMMARY

One aspect is to provide a bicycle derailleur that is relatively compact as compared to similar conventional derailleurs.

In view of the state of the known technology and in accordance with a first aspect of the present disclosure, a bicycle derailleur is provided that basically comprises a main body, a chain cage, a first pulley, a second pulley and a chain contact member. The main body is configured to be mounted to a bicycle. The chain cage is pivotally coupled to the main body for movement between at least a first orientation and a second orientation. The first pulley is rotatably coupled to one of the chain cage and the main body. The second pulley is rotatably mounted to the chain cage to move therewith relative to the main body. The chain contact member is coupled to the main body. The chain contact member includes a non-rotatable chain contact portion that projects into a chain path between the first and second pulleys while the chain cage is in the first orientation, and that is located outside of the chain path between the first and second pulleys while the chain cage is in the second orientation.

By providing the bicycle derailleur with the chain contact member in accordance with the first aspect, the distance between the pulleys can be reduced such that a shorter chain cage can be used. Thus, a bicycle derailleur can be produced that is relatively lightweight as compared to similar conventional derailleurs, but yet still relatively simple.

In accordance with a second aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the main body includes a base member, a movable member and a moving structure operatively coupled between the base member and the movable member to move the movable member and the chain cage relative to the base member.

In accordance with a third aspect of the present invention, the bicycle derailleur according to the second aspect is configured so that the chain contact member is attached to the movable member as a separate member from the movable member.

In accordance with a fourth aspect of the present invention, the bicycle derailleur according to the third aspect is configured so that the chain contact member is attached on the movable member by a least one screw.

In accordance with a fifth aspect of the present invention, the bicycle derailleur according to the second aspect is configured so that a rotational resistance structure mounted on the movable member and arranged to apply rotational resistance to the movement of the chain cage from the first orientation towards the second orientation.

In accordance with a sixth aspect of the present invention, the bicycle derailleur according to the fifth aspect is configured so that a cover member covering the rotational resistance structure, the cover member being attached to the movable member by at least one screw that attaches the chain contact member is attached to the movable member.

In accordance with a seventh aspect of the present invention, the bicycle derailleur according to the second aspect is configured so that the chain contact member and the movable member are made by one-piece member.

In accordance with an eighth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that at least the non-rotatable chain contact portion of the chain contact member is made of a resin.

In accordance with a ninth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the chain contact member includes a support portion, and the non-rotatable chain contact portion is detachably and replaceably attached to the support portion.

In accordance with a tenth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the non-rotatable chain contact portion has a chain guide surface that curves in a chain traveling direction between the first and second pulleys.

In accordance with an eleventh aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the non-rotatable chain contact portion has a chain guide surface that has a lateral dimension larger than 5.5 mm in a direction transverse to a chain traveling direction between the first and second pulleys.

In accordance with a twelfth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the non-rotatable chain contact portion has a chain guide surface that has a-dimension larger than 10 mm in a chain traveling direction between the first and second pulleys.

In accordance with a thirteenth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the first pulley is rotatably mounted on the main body.

In accordance with a fourteenth aspect of the present invention, the bicycle derailleur according to the first aspect is configured so that the first pulley is rotatably mounted on the chain cage.

Also other objects, features, aspects and advantages of the disclosed bicycle derailleur will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses one embodiment of the bicycle derailleur.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the attached drawings which form a part of this original disclosure:

FIG. **1** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between first and second pulleys in accordance with a first illustrated embodiment;

FIG. **2** is a side elevational view of the bicycle derailleur illustrated in FIG. **1** with the chain cage in a second orienta-

tion such that the chain contact member is located outside of the chain path between the first and second pulleys;

FIG. **3** is a partial perspective view of the bicycle derailleur illustrated in FIGS. **1** and **2** showing the chain contact member projecting into the chain cage;

FIG. **4** is another partial perspective view of the bicycle derailleur illustrated in FIGS. **1** and **2** showing chain contact member projecting into the chain cage;

FIG. **5** is a partial side elevational view of the bicycle derailleur illustrated in FIGS. **1** and **2** with a cover member for a rotational resistance structure of the movable member being removed;

FIG. **6** is a first perspective view of the chain contact member illustrated in FIGS. **1** to **5**;

FIG. **7** is a first perspective view of the chain contact member illustrated in FIGS. **1** to **6**;

FIG. **8** is a first perspective view of the chain contact member illustrated in FIGS. **1** to **7**;

FIG. **9** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between the first and second pulleys in accordance with a second illustrated embodiment;

FIG. **10** is a partial perspective view of the bicycle derailleur illustrated in FIG. **9** showing the chain contact member projecting into the chain cage;

FIG. **11** is a side elevational view of selected parts of the bicycle derailleur illustrated in FIG. **9** showing the chain contact member projecting into the chain cage;

FIG. **12** is a partial side elevational view of the bicycle derailleur illustrated in FIG. **9** with a cover member for a rotational resistance structure of the movable member being removed;

FIG. **13** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between first and second pulleys in accordance with a third illustrated embodiment;

FIG. **14** is a side elevational view of the bicycle derailleur illustrated in FIG. **13** with the chain cage in a second orientation such that the chain contact member is located outside of the chain path between first and second pulleys;

FIG. **15** is a perspective view of selected parts of the bicycle derailleur illustrated in FIGS. **13** and **14** showing the chain contact member projecting into the chain cage;

FIG. **16** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between first and second pulleys in accordance with a fourth illustrated embodiment;

FIG. **17** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between first and second pulleys in accordance with a fifth illustrated embodiment; and

FIG. **18** is a side elevational view of a bicycle derailleur with a chain cage in a first orientation such that a chain contact member projects into a chain path between first and second pulleys in accordance with a sixth illustrated embodiment.

DETAILED DESCRIPTION OF EMBODIMENTS

Selected embodiments will now be explained with reference to the drawings. It will be apparent to those skilled in the bicycle field from this disclosure that the following descriptions of the embodiments are provided for illustration only and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

Referring initially to FIGS. **1** and **2**, a bicycle derailleur **10** is illustrated in accordance with a first embodiment. The bicycle derailleur **10** is a rear derailleur that is configured to shift a chain **12** between rear sprockets (not shown) in a conventional manner. In the first embodiment, the bicycle derailleur **10** is operated by a Bowden cable **14**. However, the bicycle derailleur **10** is not limited to a cable operated derailleur. In other words, it will be apparent to those skilled in the bicycle field from this disclosure that the bicycle derailleur **10** can include an actuator such a motor, a pneumatic actuator, or the like.

The bicycle derailleur **10** basically comprises a main body **20**, a chain cage **22**, a first pulley **24**, a second pulley **26** and a chain contact member **28**. As explained later, the chain contact member **28** is designed to contact the chain **12** to obtain desired chain tensioning characteristics such that the length of the chain cage **22** between the first and second pulleys **24** and **26** can be reduced as compared to conventional derailleurs of the same type. The chain cage **22** pivots relative to the main body **20** about a pivot axis A. The first pulley **24** is rotatably coupled to one of the chain cage **22** and the main body **20**. In the first embodiment, as explained below, the first pulley **24** is rotatably mounted on the main body **20** with the pivot axis A of the chain cage **22** being coincident with a center axis of rotation of the first pulley **24**. The second pulley **26** is rotatably mounted to the chain cage **22** to move therewith relative to the main body **20**. The chain contact member **28** is coupled to the main body **20**. As explained later, the chain cage **22** moves relative to the chain contact member **28** as the chain cage **22** pivots relative to the main body **20** about the pivot axis A.

As seen in FIG. **1**, the chain **22** travels in a chain traveling direction T between the first and second pulleys **24** and **26** along a first chain path P**1** between the first and second pulleys **24** and **26** when the chain contact member **28** is detached. When the chain contact member **28** is installed, the chain **22** moves along a second chain path P**2** between the first and second pulleys **24** and **26**. As seen in FIG. **1**, the second chain path P**2** between the first and second pulleys **24** and **26** is longer than the first chain path P**1** when the chain contact member **28** contacts the chain **12**. In particular, in certain positions of the chain cage **22** (e.g., the chain cage in a top shift stage (gear) position), the chain contact member **28** contacts the chain **12** such that the chain **12** follows the chain path P**2** instead of the first chain path P when the chain contact member **28** is removed. Of course, in certain positions of the chain cage **22** (e.g., the chain cage in a low shift stage (gear) position), the chain cage **22** will move the second pulley **26** such that the chain contact member **28** no longer contacts the chain **12**. In this case as seen in FIG. **2**, the first and second chain paths P**1** and P**2** become coincident.

As used herein, the term "top shift stage (gear) position" refers to the bicycle derailleur **10** being in a position that corresponds to the chain **12** being guided onto a rear sprocket with the smallest number of teeth. As used herein, the term "low shift stage (gear) position" refers to the bicycle derailleur **10** being in a position that corresponds to the chain **12** being guided onto a rear sprocket with the largest number of teeth

The main body **20** is configured to be mounted to a bicycle (not shown). In the first embodiment, the main body **20** includes a base member **30**, a movable member **32** and a moving structure **34**. The moving structure **34** is operatively coupled between the base member **30** and the movable member **32** to move the movable member **32** and the chain cage **22** relative to the base member **30**. The base member **30** defines a first end of the main body **20** that releasably mounted to the bicycle via a fixing bolt **36**. The movable member **32** defines

a second end of the main body **20** that pivotally supports the chain cage **22** to the main body **20**.

In particular, the chain cage **22** is pivotally coupled to the movable member **32** of the main body **20** by a pivot axle **38** for movement between at least a first orientation (e.g., FIG. **1**) and a second orientation (e.g., FIG. **2**). Of course, the chain cage **22** can be pivoted to other orientations pivotally than the ones shown in FIGS. **1** and **2**. The pivot axle **38** can be fixed to the chain cage **22** or the movable member **32**. In the first illustrated embodiment, the pivot axle **38** is preferably a multi-part axle that is non-movably fixed to the chain cage **22**, and that is rotatably supported in the movable member **32** in the same manner as discussed in U.S. Patent Application Publication No. 2012/0083371. The first pulley **24** is rotatably attached to the pivot axle **38** by a screw **39** as seen in FIG. **4**, and thus, rotatably mounted on the mounted on the movable member **32** of the main body **20** by the pivot axle **38**. Thus, the pivot axis A of the chain cage **22** is coincident with a center axis of rotation of the first pulley **24**. Also the first illustrated embodiment, the center axis of rotation of the first pulley **24** is fixed with respect to the movable member **32**.

As seen in FIGS. **3** and **4**, the chain contact member **28** is configured and arranged to extend into a chain receiving slot S defined by a pair of chain cage plates **22***a* and **22***b* of the chain cage **22**. Preferably, the chain contact member **28** does not contact the chain cage plates **22***a* and **22***b* as the chain cage **22** pivots relative to the movable member **32** between the first orientation (e.g., FIG. **1**) and the second orientation (e.g., FIG. **2**). The chain contact member **28** is attached to the movable member **32** as a separate member from the movable member **32**. In this particular, in the first embodiment, the chain contact member **28** is attached on the movable member **32** by a least one screw. Here, in the first embodiment, as seen in FIGS. **2** and **3**, two screws **40** are used to detachably couple the chain contact member **28** to the movable member **32** of the main body **20** in a reinstallable manner.

In the first embodiment, as seen in FIGS. **1** to **3**, the moving structure **34** is a linkage that includes a first or outer link **41** and a second or inner link **42**. The outer link **41** has a first end pivotally connected to the base member **30**, and a second end pivotally connected to the movable member **32**. The inner link **42** has a first end pivotally connected to the base member **30**, and a second end pivotally connected to the movable member **32**. Thus, the outer and inner links **41** and **42** have first ends pivotally connected to the base member **30** and second ends pivotally connected to the movable member **32** to define a four bar linkage arrangement. The linkage **34** further includes a biasing member **44** that is interposed between the outer and inner links **41** and **42** to bias the movable member **32** towards one of a low shift stage position and a top shift stage position. In the first embodiment, the biasing member **44** is a coil tension spring that biases the movable member **32** towards the top shift stage position.

In the first embodiment, as seen in FIG. **5**, the bicycle derailleur **10** further comprises a rotational resistance structure **50** that is mounted on the movable member **32**. The rotational resistance structure **50** is arranged to apply rotational resistance to the movement of the chain cage **22** from the first orientation (FIG. **1**) towards the second orientation (FIG. **2**). Basically, the rotational resistance structure **50** increases the force needed to pivot the chain cage **22** relative to the movable member **32** from the first orientation towards the second orientation to avoid chain slap. Here, the rotational resistance structure **50** is an adjustable friction band such as disclosed in U.S. Patent Application Publication No. 2012/0083371. Thus, since resistance applying elements and similar to the rotational resistance structure **50** are known in the bicycle field, the rotational resistance structure **50** will not be discussed in further detail herein.

Also in the first embodiment, as seen in FIG. **5**, the bicycle derailleur **10** further comprises a one-way clutch **52** that is mounted on the movable member **32**. The one-way clutch **52** basically disengages the rotational resistance of the rotational resistance structure **50** from being applied to the pivot axle **38** as the chain cage **22** moves from the second orientation (FIG. **2**) towards the first orientation (FIG. **1**). In other words, the pivot axle **38** can freely pivot relative to the movable member **32** from the second orientation (FIG. **2**) towards the first orientation (FIG. **1**) without any frictional resistance from the rotational resistance structure **50**. The one-way clutch **52** is discussed in more detail in U.S. Patent Application Publication No. 2012/0083371. Thus, the one-way clutch **52** will not be discussed in further detail herein.

Referring back to FIGS. **1** to **3**, the movable member **32** is provided with a cover member **54** that covers the rotational resistance structure **50**. Preferably, the cover member **54** is attached to the movable member **32** by at least one of the screws **40** that attaches the chain contact member **28** is attached to the movable member **32**. Here, in the first embodiment, the cover member **54** is attached by the screws **40** and one additional screw **56**. FIG. **5** illustrates the movable member **32** with the cover member **54** removed.

As seen in FIGS. **6** to **8**, the chain contact member **28** of the first embodiment is illustrated by itself. Basically, the chain contact member **28** includes a support portion **60** and a non-rotatable chain contact portion **62**. The chain contact member **28** is coupled to the main body **20** by the support portion **60** using the screws **40** as seen in FIGS. **1** to **3**. The non-rotatable chain contact portion **62** projects into the first chain path P**1** between the first and second pulleys **24** and **26**, while the chain cage **22** is in the first orientation (FIG. **1**), and that is located outside of the first chain path P**1** between the first and second pulleys **24** and **26** while the chain cage **22** is in the second orientation (FIG. **2**). Thus, the non-rotatable chain contact portion **62** contacts the chain **12** to change the path of the chain **12** from the first chain path P**11** to the second chain path P**2**, while the non-rotatable chain contact portion **62** projects into the first chain path P**1**.

Preferably, the non-rotatable chain contact portion **62** is detachably and replaceably attached to the support portion **60**. Here, the non-rotatable chain contact portion **62** is non-rotatably attached to the support portion **60** by a screw **64**. Alternatively, the non-rotatable chain contact portion **62** and the support portion **60** can be made as one-piece member if needed and/or desired. By making the non-rotatable chain contact portion **62** replaceable, the support portion **60** can be made of a strong rigid material such as metal or a fiber-reinforced material, while the non-rotatable chain contact portion **62** is made of a material have a low coefficient of friction. Preferably, the at least the non-rotatable chain contact portion **62** of the chain contact member **28** is made of a resin. In the first embodiment, the non-rotatable chain contact portion **62** is made of a resin, while the support portion **60** is made of a lightweight metal such as aluminum.

Preferably, the non-rotatable chain contact portion **62** has a chain guide surface **62***a* that curves in the chain traveling direction T between the first and second pulleys **24** and **26**. Preferably, the chain guide surface **62** *a* has a lateral dimension larger than 5.5 mm in a direction transverse to the chain traveling direction T between the first and second pulleys **24** and **26**. Also preferably, the chain guide surface **62***a* has a dimension larger than 10 mm in a chain traveling direction T between the first and second pulleys **24** and **26**.

Also in the first embodiment, the chain cage **22** includes a preventing member **66** that prevents the chain **12** from dropping off from the first pulley **24**. The preventing member **66** is disposed near the pivot axis A of the chain cage **22** and the first pulley **24**. The preventing member **66** does not touch the chain **12** when the chain cage **22** is in any position and the chain **12** is correctly engaged with the first and second pulleys **24** and **26**. The preventing member **66** is disposed on an upper side of the chain contact member **28**.

Referring now to FIGS. **9** to **12**, a bicycle derailleur **110** is illustrated in accordance with a second embodiment. The bicycle derailleur **110** basically comprises a main body **120**, a chain cage **122**, a first pulley **124**, a second pulley **126** and a chain contact member **128**. The main body **120** includes a base member **130**, a movable member **132** and a moving structure **134**. The bicycle derailleur **110** of the second embodiment is identical to the bicycle derailleur **10** of the first embodiment, except that the chain cage **122** and the chain contact member **128** have been modified as explained below. Accordingly, the descriptions of the parts of the bicycle derailleur **110** of the second embodiment that are identical to the parts of the first embodiment have been omitted for the sake of brevity.

Here, in the second embodiment, the first pulley **124** is rotatably mounted on the chain cage **122** such that the pivot axis A of the chain cage **122** is offset from a center rotational axis B of the first pulley **124**. Accordingly, the pivot axis A of the chain cage **122**, the center rotational axis B of the first pulley **124** and a center rotational axis C of the second pulley **126** form a triangle. The chain cage **122** is pivotally coupled to the movable member **132** of the main body **120** by a pivot axle **138** for movement between at least first and second orientations similar to the first embodiment. However, the first pulley **124** is not mounted to the pivot axle **138**. Rather, the first pulley **124** is mounted to the chain cage **122** by a screw **139**.

The chain contact member **128** is configured and arranged to extend into the chain receiving slot S defined by a pair of chain cage plates **122***a* and **122***b* of the chain cage **122**. Here, as seen in FIG. **11**, the chain contact member **128** is attached to an inward side of the movable member **132** by a pair of screws **140** in a reinstallable manner.

Similar to the first embodiment, as seen in FIG. **12**, the bicycle derailleur **110** further comprises a rotational resistance structure **150** and a one-way clutch **152**. The rotational resistance structure **150** and the one-way clutch **152** are the same as in the first embodiment except for minor differences that do not affect the way they operate.

Similar to the first embodiment, the chain contact member **128** includes a support portion **160** and a non-rotatable chain contact portion **162**. The chain contact member **128** is coupled to the movable member **132** of the main body **120** by the support portion **160** using the screws **140** as seen in FIG. **11**. The non-rotatable chain contact portion **162** projects into the first chain path P**1** between the first and second pulleys **124** and **126**, while the chain cage **122** is in an orientation such as seen in FIG. **9**, and that is located outside of the first chain path P**1** between the first and second pulleys **124** and **126** while the chain cage **122** is in a second orientation (FIG. **2**). Thus, the non-rotatable chain contact portion **162** contacts the chain **12** to change the path of the chain **12** from the first chain path P**1** to the second chain path P**2**, while the non-rotatable chain contact portion **162** projects into the first chain path P**1**.

Preferably, the non-rotatable chain contact portion **162** is detachably and replaceably attached to the support portion **160**. Here, the non-rotatable chain contact portion **162** is non-rotatably attached to the support portion **160** by a screw **164**. Alternatively, the non-rotatable chain contact portion **162** and the support portion **160** can be made as one-piece member if needed and/or desired. By making the non-rotatable chain contact portion **162** replaceable, the support portion **160** can be made of a strong rigid material such as metal or a fiber-reinforced material, while the non-rotatable chain contact portion **162** is made of a material have a low coefficient of friction. Preferably, the at least the non-rotatable chain contact portion **162** of the chain contact member **128** is made of a resin. In the second embodiment, the non-rotatable chain contact portion **162** is made of a resin, while the support portion **160** is made of a lightweight metal such as aluminum.

Also in the second embodiment, the chain cage **122** includes a preventing member **166** that prevents the chain **12** from dropping off from the first pulley **124**. The preventing member **166** is disposed near the pivot axis A of the chain cage **122** and the first pulley **124**. The preventing member **166** does not touch the chain **12** when the chain cage **122** is in any position and the chain **12** is correctly engaged with the first and second pulleys **124** and **126**. The preventing member **166** is disposed on an upper side of the chain contact member **128**.

Referring now to FIGS. **13** to **15**, a bicycle derailleur **210** is illustrated in accordance with a third embodiment. The bicycle derailleur **210** basically comprises a main body **220**, a chain cage **222**, a first pulley **224**, a second pulley **226** and a chain contact member **228**. The main body **220** includes a base member **230**, a movable member **232** and a moving structure **234**. The bicycle derailleur **210** of the third embodiment is identical to the bicycle derailleur **110** of the first embodiment, except that the chain cage **222** and the chain contact member **228** have been modified as explained below. Accordingly, the descriptions of the parts of the bicycle derailleur **210** of the third embodiment will be limited to the differences for the sake of brevity.

In the third embodiment, the chain contact member **228** basically includes a support portion **260**, a non-rotatable chain contact portion **262** and a positioning portion **263**. The support portion **260** and the non-rotatable chain contact portion **262** are integrally formed as a one-piece member that is attached to the movable member **232** by an attachment member **265**. The support portion **260** is pivotally mounted to the attachment member **265**, which is attached to the movable member **232** by one of two screws **240**. As best seen in FIG. **15**, a biasing member **269** (e.g., a torsion spring) is provided between the support portion **260** and the attachment member **265** to bias the non-rotatable chain contact portion **262** into contact with the positioning portion **263**. The biasing member **269** has a coiled portion disposed on a pivot pin **270**, a first end disposed in a hole in the support portion **260**, and a second end disposed in a hole in the attachment member **265**. The positioning portion **263** is attached to the movable member **232** by one of two screws **240**. The screws **240** are also used to attach a cover member **254** that covers the rotational resistance structure and the one-way clutch.

In the embodiment, the support portion **260** has an end **260***a* that is pivotally attached to the attachment member **265** near the pivot axis A of the chain cage **222** and the first pulley **224** such that the end **260***a* acts as a preventing member to prevent the chain **12** from dropping off from the first pulley **224**. Thus, the chain contacting member **228** and the preventing member (i.e., the end **260***a*) are made as one-piece member in this third embodiment. The end **260***a* of the support portion **260** does not touch the chain **12** when the chain cage **222** is in any position and the chain **12** is correctly engaged with the first and second pulleys **224** and **226**.

In this third embodiment, the chain contacting member **228** has a slot or through hole **228***a* for receiving the chain **12**

therethrough. As the chain cage **222** pivots about the pivot axis A, the relative position of the chain contacting member **228** changes relative to the chain cage **222** such that the chain **12** follows the second chain path P2 as seen in FIG. **13**. Similar to the prior embodiment, the chain **12** does not contact the chain contacting member **228** while the chain cage **222** is in at least one orientation as seen in FIG. **14**.

Referring now to FIG. **16**, a bicycle derailleur **310** is illustrated in accordance with a fourth embodiment. The bicycle derailleur **310** basically comprises a main body **320**, a chain cage **322**, a first pulley **324**, a second pulley **326** and a chain contact member **328**. The main body **320** includes a base member **330**, a movable member **332** and a moving structure **334**. The bicycle derailleur **310** of the fourth embodiment is identical to the bicycle derailleur **210** of the third embodiment, except that the chain cage **322** and the chain contact member **328** have been modified as explained below. Accordingly, the descriptions of the parts of the bicycle derailleur **310** of the fourth embodiment will be limited to the differences for the sake of brevity.

In the fourth embodiment, the chain contact member **328** basically includes a support portion **360**, a non-rotatable chain contact portion **362** and a positioning portion **363**. The chain contact member **328** is identical to the chain contact member **228**, except that the support portion **360** of the chain contact member **328** is pivotally attached directly to the chain cage **322** by a pivot pin **370**. Thus, the chain cage **322** is identical to the chain cage **222**, except that the chain cage **322** has been modified so that the pivot pin **370** can be directly fixed to the chain cage **322**. Similar to the third embodiment, the support portion **360** has an end **360***a* that acts as a preventing member to prevent the chain **12** from dropping off from the first pulley **324**. Similar to the third embodiment, the non-rotatable chain contact portion **362** of chain contact member **328** has a slot **328***a* for receiving the chain **12** therethrough.

Referring now to FIG. **17**, a bicycle derailleur **410** is illustrated in accordance with a fifth embodiment. The bicycle derailleur **410** basically comprises a main body **420**, a chain cage **422**, a first pulley **424**, a second pulley **426** and a chain contact member **428**. The main body **420** includes a base member **430**, a movable member **432** and a moving structure **434**. The bicycle derailleur **410** of the fifth embodiment is identical to the bicycle derailleur **210** of the third embodiment, except that the chain cage **422** and the chain contact member **428** have been modified as explained below. Accordingly, the descriptions of the parts of the bicycle derailleur **410** of the fifth embodiment will be limited to the differences for the sake of brevity.

In the fifth embodiment, the chain contact member **428** basically includes a support portion **460** and a non-rotatable chain contact portion **462**. The chain contact member **428** is identical to the chain contact member **228**, except that the support portion **460** of the chain contact member **428** is non-pivotally attached directly to the movable member **432** by one of the screws **440**. Thus, the chain cage **422** is identical to the chain cage **222**, except that the chain cage **422** has been modified to include a preventing member **466** that is arranged to prevent the chain **12** from dropping off from the first pulley **424**.

Referring now to FIG. **18**, a bicycle derailleur **510** is illustrated in accordance with a sixth embodiment. The bicycle derailleur **510** basically comprises a main body **520**, a chain cage **522**, a first pulley **524**, a second pulley **526** and a chain contact member **528**. The main body **520** includes a base member **530**, a movable member **532** and a moving structure **534**. The bicycle derailleur **510** of the sixth embodiment is identical to the bicycle derailleur **210** of the third embodiment, except that the chain cage **522** and the chain contact member **528** have been modified as explained below. Accordingly, the descriptions of the parts of the bicycle derailleur **510** of the sixth embodiment will be limited to the differences for the sake of brevity.

In the sixth embodiment, the chain contact member **528** basically includes a support portion **560** and a non-rotatable chain contact portion **562**. The chain contact member **528** is identical to the chain contact member **428**, except that the chain contact member **528** and the movable member **532** are made by one-piece member. The chain cage **522** is identical to the chain cage **222**, except that the chain cage **522** has been modified so as to include a preventing member **566** that is arranged to prevent the chain **12** from dropping off from the first pulley **524**.

In understanding the scope of the present invention, the term "comprising" and its derivatives, as used herein, are intended to be open ended terms that specify the presence of the stated features, elements, components, groups, integers, and/or steps, but do not exclude the presence of other unstated features, elements, components, groups, integers and/or steps. The foregoing also applies to words having similar meanings such as the terms, "including", "having" and their derivatives. Also, the terms "part," "section," "portion," "member" or "element" when used in the singular can have the dual meaning of a single part or a plurality of parts. Finally, terms of degree such as "substantially", "about" and "approximately" as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed.

While only selected embodiments have been chosen to illustrate the present invention, it will be apparent to those skilled in the art from this disclosure that various changes and modifications can be made herein without departing from the scope of the invention as defined in the appended claims. For example, the size, shape, location or orientation of the various components can be changed as needed and/or desired so long the result is not significantly changed. Components that are shown directly connected or contacting each other can have intermediate structures disposed between them. The functions of one element can be performed by two, and vice versa. The structures and functions of one embodiment can be adopted in another embodiment. It is not necessary for all advantages to be present in a particular embodiment at the same time. Every feature which is unique from the prior art, alone or in combination with other features, also should be considered a separate description of further inventions by the applicant, including the structural and/or functional concepts embodied by such feature(s). Thus, the foregoing descriptions of the embodiments according to the present invention are provided for illustration only, and not for the purpose of limiting the invention as defined by the appended claims and their equivalents.

What is claimed is:

1. A bicycle derailleur comprising:

a main body configured to be mounted to a bicycle;

a chain cage pivotally coupled to the main body for movement between at least a first orientation and a second orientation;

a first pulley rotatably coupled to one of the chain cage and the main body;

a second pulley rotatably mounted to the chain cage to move therewith relative to the main body; and

a chain contact member coupled to the main body, the chain contact member including a non-rotatable chain contact portion that projects into a chain path between

the first and second pulleys while the chain cage is in the first orientation and that is located outside of the chain path between the first and second pulleys while the chain cage is in the second orientation.

2. The bicycle derailleur according to claim **1**, wherein the main body includes a base member, a movable member and a moving structure operatively coupled between the base member and the movable member to move the movable member and the chain cage relative to the base member.

3. The bicycle derailleur according to claim **2**, wherein the chain contact member is attached to the movable member as a separate member from the movable member.

4. The bicycle derailleur according to claim **3**, wherein the chain contact member is attached on the movable member by a least one screw.

5. The bicycle derailleur according to claim **2**, further comprising

a rotational resistance structure mounted on the movable member and arranged to apply rotational resistance to the movement of the chain cage from the first orientation towards the second orientation.

6. The bicycle derailleur according to claim **5**, further comprising

a cover member covering the rotational resistance structure, the cover member being attached to the movable member by at least one screw that attaches the chain contact member is attached to the movable member.

7. The bicycle derailleur according to claim **2**, wherein the chain contact member and the movable member are made by one-piece member.

8. The bicycle derailleur according to claim **1**, wherein at least the non-rotatable chain contact portion of the chain contact member is made of a resin.

9. The bicycle derailleur according to claim **1**, wherein the chain contact member includes a support portion, and the non-rotatable chain contact portion is detachably and replaceably attached to the support portion.

10. The bicycle derailleur according to claim **1**, wherein the non-rotatable chain contact portion has a chain guide surface that curves in a chain traveling direction between the first and second pulleys.

11. The bicycle derailleur according to claim **1**, wherein the non-rotatable chain contact portion has a chain guide surface that has a lateral dimension larger than 5.5 mm in a direction transverse to a chain traveling direction between the first and second pulleys.

12. The bicycle derailleur according to claim **1**, wherein the non-rotatable chain contact portion has a chain guide surface that has a dimension larger than 10 mm in a chain traveling direction between the first and second pulleys.

13. The bicycle derailleur according to claim **1**, wherein the first pulley is rotatably mounted on the main body.

14. The bicycle derailleur according to claim **1**, wherein the first pulley is rotatably mounted on the chain cage.

* * * * *